

REMARKS

Reconsideration of the above-identified application in view of the following remarks is respectfully requested. Claims 1-40 are currently pending. Claims 15 and 16 have been objected to because of minor typographical informalities. Similarly, claim 40 has been rejected under 35 U.S.C. §112, first paragraph, because of a minor typographical error. Claims 15, 16, and 40 have been appropriately amended to obviate these concerns.

Claims 17-40 have been provisionally rejected under the judicially created doctrine of obviousness-type double patenting in view of claims 1-8, 14-16, 18, 19, 21-24, 29-62, and 65 of co-pending Application No. 09/715,530. A terminal disclaimer in accordance with 37 CFR § 1.321 is submitted herewith to obviate these rejections.

Claims 7 and 14 have been objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Similarly, claims 26 and 33 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims and if the above-noted obviousness-type double patenting rejection was overcome.

Finally, claims 1-6, 8-13, and 15-40 stand rejected under 35 U.S.C. §103(a) as obvious. Applicant respectfully disagrees and traverses each of these rejections. Additionally, Applicant has amended independent claims 17 and 40 such that they now recite “a direct liquid feed fuel cell system” thereby further patentably distinguishing the presently claimed invention from the cited prior art. No new matter has been added. For purposes of clarity, Applicant addresses each of the Examiner’s specific concerns relating to obviousness in the order set forth in the Office Action.

Claim Rejections under 35 U.S.C. § 103(a)

Claims 17, 18, 23-25, 27-32, and 34-40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over FR 2667728 in view of DE 19820756 in view of U.S. Patent No.

5,874,182 to Wilkerson *et al.* (see Office Action at page 3, paragraph 5). Applicant respectfully disagrees and traverses these rejections.

As an initial matter, Applicant wishes to point out that claim 17 has been amended such that it now recites a direct liquid feed fuel cell system. Because of these additional claim limitations, among other reasons, there is no basis to conclude that one of ordinary skill in the art would be motivated to combine the teachings of the above-identified references in the manner suggested by the Examiner. Support for these additional claim limitations may be found, for example, in the specification at page 1, line 22. No new matter has been added.

First, Applicant notes that the Examiner has concluded that one of ordinary skill in the art would be motivated to use the perforated silicon workpiece of DE 19820756 as the anode and cathode catalyst support structures of FR 2667728. In this regard, the Examiner has stated:

Therefore, the invention as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made because the artisan would be motivated to use the perforated silicon workpiece of the German reference as the anode and cathode catalyst supporting structures of the French reference. In the abstract, the German references teach that “the incompletely perforated second regions provide the perforated workpiece with increased strength and stability in an inexpensive manner, so that the risk of braking during mounting is reduced.” Accordingly, the artisan would be motivated by this disclosure to use the workpiece of the German reference as the catalyst supporting structure in the electrodes of the French reference.

Office Action at paragraph spanning pages 4-5.

Applicant respectfully disagrees with the Examiner’s syllogism in this regard because, among other reasons, such a modification would necessarily render the fuel cell of FR 2667728 inoperable and thus unsatisfactory for its intended purposes. FR 2667728 is directed to a gaseous hydrogen-oxygen type (*i.e.*, not a direct liquid feed type) of fuel cell that comprises two porous conducting electrodes separated by a liquid electrolyte filled porous polymeric matrix. Importantly, the porous electrodes taught by FR 2667728 are disclosed as

being “chosen from among porous carbons, metal carbides,” and also “gold metallic foam” (see English language translation of FR 2667728 at page 4, last paragraph, and Examples 1-6). In all instances, the porous electrode structures taught by FR 2667728 are made from an inherently conductive material (*e.g.*, porous carbons, metal carbides, gold foams), meaning that they are all capable of having sufficient electron transport to satisfactorily operate a fuel cell. Put differently, the porous electrode structures taught by FR 2667728 are in all instances “current conductors” - current conductors that are capable of collecting electrons (on the anode side) and/or discharging electrons (on the cathode side), thereby enabling a combined electrode assembly to operate satisfactorily as a fuel cell. Moreover, and as appreciated by those skilled in the art, the term “current conductor” is used interchangeably with the term “current collector”; and both terms are used to describe the inherently conductive material (not semi-conductive or insulating material) of a fuel cell that collects electrons (on the anode side) or discharges electrons (on the cathode side).

Without any further processing, the perforated silicon workpieces (*i.e.*, “support structures”) taught by DE 19820756 are not capable of functioning satisfactorily as fuel cell electrode structures. This is because the disclosed silicon workpieces are only “semi-conductive” in character and have a stated resistivity of 5 Ω cm (probably because they are intended to function primarily as “valuable optical or mechanical filters”). Indeed, the perforated and semi-conductive silicon workpieces taught by DE 19820756 (unlike the specially processed silicon structures of the present invention) are not fully saturated with a selected dopant (*e.g.*, Phosphorus or Boron); thus they have a somewhat standard and relatively high resistivity value of about 5 Ω cm (see English language translation of DE 19820756 at page 4, line 17). As is appreciated by those skilled in the art, the stated resistivity of 5 Ω cm is far too great to enable the silicon workpieces of DE 19820756 to function satisfactorily as current collectors (and thus as electrode structures) in a fuel cell (verified by the inventors of the present invention as they tried unsuccessfully to build and operate such a silicon-based fuel cell).

Conversely, the resistivity of the specially doped (*i.e.*, post-processing doping to saturation limit) silicon electrode structures of the present invention have a disclosed resistivity

of only about 0.05 Ω cm. This two orders of magnitude difference in resistivity is because the specially doped silicon electrode structures of the present invention have been fully saturated with a selected dopant, namely and for example, Phosphorus (*see* Example 1 of specification at page 38, step 1.20, and at page 40, step 2.13, wherein disclosed process steps teach the diffusion doping of a porous silicon substrate to make the porous silicon sufficiently conductive by achieving a resistivity of approximately 50 m Ω cm). In short, the fully doped silicon electrode structures of the present invention are capable of functioning satisfactorily as current conductors and thus as electrode structures (unlike the partially doped silicon workpieces taught by DE 19820756), thereby enabling the claimed electrode assembly to operate satisfactorily as a fuel cell. The silicon workpieces taught by DE 19820756, on the other hand, are not capable of functioning satisfactorily as current conductors for a fuel cell. Therefore, one of ordinary skill in the art would not have been motivated to use the silicon workpieces of DE 19820756 as the electrodes of FR 2667728.

The law is clear that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984). Moreover, the mere fact that the prior art could be modified does not provide a sufficient basis for making an obviousness rejection, unless the prior art references suggested the desirability of the modification. *Id.* at 1127; *In re Sponnoble*, 160 USPQ 237, 244 (CCPA 1969) (holding that prior art references teach away from their combination if such a combination produces a seemingly inoperative device). There is no suggestion in the prior art of record for making the Examiner's proposed modifications. Moreover, and because the prior art invention being modified (*i.e.*, fuel cell of FR 2667728) would result in an inoperative device (thus unsatisfactory for its intended purpose), there can be no suggestion or motivation to make the Examiner's proposed modifications.

Second, Applicant also notes that the Examiner has further concluded that in further view of U.S. Patent No. 5,874,182 to Wilkerson *et al.* one of ordinary skill in the art would also be motivated "to feed an aqueous methanol/acid to the anode, and thereby to the

electrolyte, of the French reference.” (see Office Action at page 5, lines 5-9). Applicant respectfully disagrees.

Although the patent to Wilkerson *et al.* discloses that, in some embodiments, an acidic aqueous methanol is the preferred feed to the anode, it does not teach or otherwise suggest the combination of references contemplated by the Examiner. On the contrary, those of ordinary skill in the art would find no motivation whatsoever to deliver a liquid methanol/acid solution to the anode of the FR 2667728. In large part, this is because the fuel cell design disclosed by FR 2667728 is expressly limited to a non-liquid feed hydrogen-oxygen type of fuel cell. Accordingly and view of the foregoing, Applicant respectfully requests that the above-identified obviousness rejections corresponding to claims 17, 18, 23-25, 27-32, and 34-40 be withdrawn.

Claims 19-22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over FR 2667728 in view of DE 19820756 in view of U.S. Patent No. 5,874,182 to Wilkerson *et al.* as applied to claims 17, 18, 23-25, 27-32, and 34-40 above and further in view of PCT International Publication No. WO 98/217777. (see Office Action at page 6, paragraph 6). Applicant respectfully disagrees and traverses these rejections.

Because claims 19-22 all ultimately depend upon rejected independent base claim 17, and because Applicant has established the nonobviousness of claim 17 for the reasons set forth above, it follows, *a fortiori* and based on identical reasoning as set forth above, that claims 19-22 are likewise nonobvious. Accordingly, Applicant respectfully request that the above-identified obviousness rejections corresponding to claims 19-22 be likewise withdrawn.

Claims 1-6, 8-13, and 15 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over FR 2667728 in view of DE 19820756 in view of U.S. Patent No. 5,874,182 to Wilkerson *et al.* as applied to claims 17, 18, 23-25, 27-32, and 34-40 above and further in view of U.S. Patent No. 6,413,671 to Mercuri *et al.* (see Office Action at page 7, paragraph 7). Applicant respectfully disagrees and traverses these rejections.

With respect to claims 1, 8, and 15, and in addition to the Examiner’s inapposite syllogism (cited above) regarding his assertion that one of ordinary skill in the art would be

motivated to use the perforated silicon workpiece of DE 19820756 as the anode and cathode catalyst support structures of FR 2667728, the Examiner further states that:

DE '756 does not expressly teach that the other side of the substrate comprises channels such that the pores are in fluid communication with channels on both sides of the substrate, as recited in claims 1, 8, and 15.

Office Action at page 7, lines 6-8.

Applicant agrees with the Examiner to the extent that DE 19820756 does not teach or otherwise suggest fluid delivery and removal channels on both sides of a substrate, wherein the opposing channels are in fluid communication with each other. In order to remedy this shortcoming, the Examiner relies on U.S. Patent No. 6,413,671 to Mercuri *et al.* and first argues “that upon incorporating the substrate of DE '756 into the fuel cell of the French reference [FR 2667728], the artisan [one of ordinary skill in the art] would be motivated to use the top [planar] surface of the substrate [perforated silicon workpiece of DE 19820756] as the surface facing the electrolyte since it has more surface area” (*emphasis added*). The Examiner then goes on to argue that because Mercuri *et al.* teaches fluid removal passages on the surface facing the electrolyte (to maintain gas-catalyst contact in the event of adjacent channel blockage), this same artisan would also be sufficiently motivated “to incorporate channels onto the inside surface of the electrodes of the French reference, corresponding to the top [otherwise planar] surface of the substrates of DE '756” (*see* Office Action at paragraph spanning pages 7-8). Applicant respectfully disagrees with the Examiner’s arguments because they are incongruent.

More specifically, it is incongruent to first argue that an artisan of ordinary skill would be motivated to use a top planar surface “as the surface facing the electrolyte since it has more contact area”; and then argue that this same artisan would be motivated “to incorporate channels” onto that same top planar surface. These arguments are incongruent because both the top and bottom surfaces (associated with the substrates of DE 19820756 being modified) would now require channels, thereby defeating the Examiner’s rationale regarding the necessary motivation (*i.e.*, more contact area) to use a top planar surface as the surface facing the

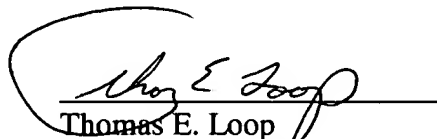
electrolyte. Put simply, an artisan of ordinary skill would be indifferent as to which surface of the substrate (*i.e.*, top or bottom) faces the inner electrolyte because both surfaces would now have channels (either of which may have more surface or contact area). The prior art references relied upon by the Examiner do not teach or otherwise suggest channels of both side of an electrode structure. Accordingly, Applicant respectfully request that the above-identified obviousness rejections corresponding to claims 1-6, 8-13, and 15 be likewise withdrawn.

Claim 16 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over FR 2667728 in view of DE 19820756 in view of U.S. Patent No. 5,874,182 to Wilkerson *et al.* in view of U.S. Patent No. 6,413,671 to Mercuri *et al.* as applied to claims 1-6, 8-13, and 15 above and further in view of U.S. Patent No. 5,723,228 to Okamoto. (*see* Office Action at page 8, paragraph 8). Applicant respectfully disagrees and traverses these rejections.

Because Applicant has established the nonobviousness of claims 1-6, 8-13, and 15 for the reasons set forth above, it follows *a fortiori* that claim 16 is likewise nonobvious. Accordingly, Applicant respectfully requests that the above-identified obviousness rejection to claim 16 be likewise withdrawn.

In view of the above remarks allowance of claims 1-40 is earnestly solicited. A good faith effort has been made to place this application in condition for allowance. However, if any further matter requires attention prior to allowance, the Examiner is requested to contact the undersigned attorney at (206) 381-3100 to resolve the same.

Respectfully Submitted,


Thomas E. Loop
Registration No. 42,810